

TECHNIQUE OF THE PAINTING PROCESS IN THE ROCK-CUT TEMPLES AT BADAMI

BY S. PARAMASIVAN

(*Archaeological Chemist, Government Museum, Madras*)

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I. *Introduction*

THE rock-cut temples at Badami ($15^{\circ} 55' N.$ and $75^{\circ} 41' E.$) are situated in the Kaladgi Collectorate, Bijapur District, in the Deccan, on the metre gauge line of the M.S.M. Railway, connecting Gadag with Sholapur. The caves are excavated in the face of an almost perpendicular scarp of hard, sandstone rock, very near the town of Badami, the ancient Chalukyan capital. Three of them are Brahminical and one Jain.

It is likely that the caves were once fully painted over. But the paintings have suffered so much damage through vicissitudes of time and elements that only a few of them are left in tact. Remains of them, however, still occur on the concave surface of the heavily vaulted cornice in Cave No. IV. Burgess¹ and Codrington² have given reference to the Badami paintings, but it was Dr. Stella Kramrisch,³ who made a systematic study of them, and drew attention to their importance.

These are the earliest examples of Brahminical wall paintings, which can be definitely dated. The Cave IV has a dated inscription of King Mangalisvara, son of Pulakesin I of the Chalukyan dynasty. It records the completion of the cave in 578 A.D. Thus the paintings should have been executed about the same time or a little later. This dating is also confirmed from other sources. The paintings in Cave IV have a peculiarly interesting relationship to the decorations of "Chosroes and Shirin" in Cave No. I at Ajanta. This scene, it must be admitted, is a testimony of the embassy of the great king who visited the court of Pulakesin I in 625 A.D. Thus the paintings in Cave IV probably date from 6th or 7th century A.D.

II. *Experimental Investigations*

In order to reconstruct the methods and materials used by the Chalukyan artists at Badami, some fragments of painted *stucco* from Cave IV were supplied to the author through the kindness of the Director-General of Archæology in India. The painted *stucco* consists of *rough plaster* of clay supporting the layer of paint.

In discussing the methods of production of these paintings, there are four principal elements to be considered, namely, the *carrier*, the *ground*, the *pigments* and the *binding medium* used with the pigments.

1. *The Carrier*.—

The paintings are on the cornice in Cave IV. Hence the rocky surface of sandstone acts as the *carrier*, supporting the plaster and the pigment. The rocky surface has been left rough so that the plaster might adhere firmly to the surface.⁴ The hard, compact, non-porous surface of sandstone has eliminated the possibility of any efflorescence appearing on the surface.⁵

2. *The Ground*.—

The following experiments were conducted in order to determine the nature of the *ground* that had been prepared by the Badami artists to receive the paint :—

Study of the microsection.—A microsection of the painted *stucco* showing all the different layers composing it was prepared.⁶ On examining it under the microscope, it revealed the presence of a single line of cleavage or junction at a depth of 0.1 mm. below the top of the painted layer. This junction suggested the presence of two distinct layers in the *stucco*, namely, those of the *rough plaster* and the paint film. There was no evidence for the existence of a third layer of *fine plaster* such as is found in other ancient wall paintings in India.⁷ The thicknesses of the different layers were as follows :—

<i>Rough plaster</i>	0.4 mm.—0.6 mm.
Paint film	0.1 mm.

Thus the *painted stucco* at Badami is relatively much thinner than those at Ajanta,⁸ Ellora,⁸ Bagh,⁹ Tanjere,¹⁰ Sittannavasal,¹¹ etc.

On account of the extreme thinness of the *stucco* and the *rough plaster*, and their tendency to crumble easily, it was not possible to split up the *stucco* along the junction.

Size of the particles in the plaster.—The *rough plaster* was completely freed from the paint layer and crushed gently between the fingers. It was then subjected to the mechanical separation of the particles composing it by Robinson's method.¹² The particles were very small and varied in size from 14 μ to 70 μ and consisted mostly of particles of silica and alumina. It may be remarked here that similar small particles have not been met with in the *rough plaster* from other Indian sites already referred to. Since the particles were extremely small and the surface of the *rough plaster* was relatively smoother than those from other sites, *fine plaster* was found to be quite unnecessary.

Analysis of the rough plaster.—In order to determine how the rough plaster, which carries the paint, was prepared, its chemical composition was determined. The results of chemical analysis of representative specimens are as follows :—

	Rough Plaster (Per cent.)
Moisture	2.55
Combined water and organic matter ..	25.68
Silica, SiO ₂	43.98
Iron, Fe ₂ O ₃	1.75
Alumina, Al ₂ O ₃	21.28
Manganese, MnO	0.21
Lime, CaO	2.97
Magnesia, MgO	0.49
Alkalies	0.87
Phosphorus, P ₂ O ₅	0.09
Titanium, TiO ₂	Trace
Nitrogen, N ₂	0.16
TOTAL ..	100.03

The results of analysis show that silica and alumina are present in comparatively large proportions. Iron and lime occur to the extent of 1.75% and 2.97% respectively. Their proportion is so low that they could have been present only as impurities, and not purposely added. Hence the consolidation of the plaster has not been brought about by lime. The proportion of combined water and organic matter is 25.68%. The organic matter must be partly the vegetable fibres present in the plaster and partly the organic binding medium, if any, present in the plaster. The proportion of nitrogen shows that organic nitrogenous substance, probably in the form of an organic binding medium, is also present. The other impurities occurring in the plaster are not of much significance.

Silica, iron and lime serve as the inert materials.¹³

Technique of laying the ground.—The *rough plaster* could be notched between fingers and easily reduced to powder. It readily softened in cold and boiling water. Thus, any binding medium, if present in the plaster, must be water-soluble, and not lime. A fragment of the *rough plaster* failed to answer Molisch's test with α -naphthol, thereby showing the absence of gum. Methylene blue, and methyl violet imparted no stain to the plaster, but acid green and iodoeosin stained it.¹⁴ Hence glue is present in the *rough plaster* as the binding medium. In addition, the consolidation of the plaster has also been brought about by the plasticity of clay¹⁵ and the vegetable fibres¹⁶ present in it.

Method of laying the ground.—From the experimental investigations, it is clear that the artists prepared the *rough plaster* of earth containing a large proportion of clay. It was then worked with water and glue. In order that the plaster might consolidate properly, vegetable fibres were also added. The plaster was applied to the ceilings and cornices and probably, also to the walls to a thickness depending upon the inequalities of the surface of the *carrier* and smoothed, probably with a trowel or a polishing stone. No *fine plaster* was applied over the *rough plaster*.

3. *The Pigments.*—

The following pigments were identified¹⁷ :—

Yellow Ochre.	Lime.
Red Ochre	Terre verte.
Carbon.	

4. *The Binding Medium.*—

The Binding Medium determines the nature of the technique adopted in painting, that is, whether it is one of *fresco*, *tempera*, or the like. The paint film readily softened in cold and boiling water, and disintegrated. Hence the technique adopted is not *fresco*. It is evident that a water-soluble *binding medium* has been used. That gum has not been used as a binding medium was shown by the failure of the paint film to answer Molisch's test with α -naphthol. Methylene blue and methyl violet failed to stain the paint film, but acid green and iodoeosin stained it.¹⁸ Thus the *binding medium* should have been glue or casein. But a small fragment of the paint film was covered with a drop of water on a microscopic slide and the water evaporated. A glue ring characteristic of glue crackle¹⁹ was formed, which was seen through a microscope. Thus glue has been used as a binding medium.

Since the technique used is one of *tempera*, it is difficult to find out the extent of the work that was done in the course of a single day from a study

S. Paramasivan

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Badami:—Cave No. 4 Front View
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